

10/018229

## CERTIFICATION UNDER 37 CFR 1.10

I hereby certify that this Transmittal Letter and the papers indicated as being transmitted therewith are being deposited with the United States Postal Service on this date shown below in an envelope as "Express Mail Post Office to Addressee" under the below indicated Mailing Label Number, addressed to: Box PCT, Commissioner for Patents, U.S. Patent and Trademark Office, Washington, D.C. 20231.

Mailing Label No.: EF232848408USDeposit Date: December 12, 2001Name: Shari SausATTORNEY'S DOCKET NO. CULLP0162US

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
(DO/EO/US)

In re national phase of:

Applicant(s): John Lionel Brauer et al.  
International Application No.: PCT/AU00/00617  
International Filing Date: May 31, 2000  
Priority Date Claimed: May 31, 1999 and February 25, 2000  
Title of Invention: OZONE GENERATING APPARATUS

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED  
OFFICE (DO/EO/US) CONCERNING ENTRY INTO U.S. NATIONAL  
PHASE UNDER 35 U.S.C. 371

Box PCT  
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U.S. Patent and Trademark Office  
Washington, D.C. 20231

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information under 35 U.S.C. 371:

1. This express request to immediately begin national examination procedures (35 U.S.C. 371(f)).
2. The U.S. National Fee (35 U.S.C. 371(c)(1)) and other fees (37 CFR 1.492) as indicated below.

3. A copy of the International application (35 U.S.C. 371(c)(2)):
- a. ☒ is transmitted herewith  
(International Publication No. WO 00/74187 A1 ).
  - b. ☐ is not required, as the application was filed with the United States Receiving Office.
  - c. ☐ has been transmitted by the International Bureau. A copy of Form PCT/1B/308 is enclosed.
4. ☐ An accurate translation of the International application into the English language (35 U.S.C. 371(c)(2)) is transmitted herewith.
5. Amendments to the claims of the International application under PCT Article 19 (35 U.S.C. 371(c)(3)):
- a. ☐ are transmitted herewith.
  - b. ☐ have been transmitted by the International Bureau.
6. ☐ An accurate translation of the amendments to the claims under PCT Article 19 (38 U.S.C. 371(c)(3)) is transmitted herewith.
7. A copy of the international preliminary examination report (PCT/IPEA/409)
- a. ☒ is transmitted herewith.
  - b. ☐ is not required as the United States Patent and Trademark Office was the IPEA.
8. Annex(es) to the international preliminary examination report
- a. ☐ is/are transmitted herewith.
  - b. ☐ is not required as the United States Patent and Trademark Office was the IPEA.
9. ☐ An accurate translation of the annexes to the international preliminary examination report is transmitted herewith.
10. ☐ An oath or declaration of the inventor (35 U.S.C. 371(c)(4)) complying with 35 U.S.C. 115 is submitted herewith.

11. An International Search Report (PCT/ISA/210)
  - a. ☒ is transmitted herewith.
  - b. ☐ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was searched by the United States International Searching Authority.
12. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98 is transmitted herewith, along with Form PTO-1449 and copies of citations listed.
13. ☐ An assignment document is transmitted herewith for recording, along with a separate cover sheet.
14. ☐ A preliminary amendment is enclosed.
15. ☒ Small entity status is claimed.
16. ☐ Other:

\*After any attached preliminary amendment reducing the number of claims and/or deleting multiple dependencies.

[ ] Please charge our Deposit Account No. 18-0988 in the amount of \$\_\_\_\_\_. A duplicate copy of this sheet is enclosed.

**WARNING: TO AVOID ABANDONMENT OF THE APPLICATION THE BASIC NATIONAL FEE MUST BE PAID WITHIN THE 20/30 MONTH TIME LIMIT.**

Transmittal Letter to United States Designated/Elected Office

Page 5

16. The Commissioner is hereby authorized to charge the following additional fees that may be required by this paper and during the entire pendency of this application to our Deposit Account No. 18-0988:

a. ☒ 37 CFR 1.492(a)(1), (2), (3), (4) and (5) (basic national fee)

WARNING: BECAUSE FAILURE TO PAY THE NATIONAL FEE WITHIN 30 MONTHS WITHOUT EXTENSION (37 CFR S 1.495(B)(2)) RESULTS IN ABANDONMENT OF THE APPLICATION, IT WOULD BE BEST TO ALWAYS CHECK THE ABOVE BOX.

b. ☐ 37 CFR 1.492(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims cancelled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.492(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

Respectfully submitted,



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**OZONE GENERATING APPARATUS****TECHNICAL FIELD**

This invention relates to ozone generating apparatus and has particular relevance to apparatus which operates on corona discharge principles, utilises the phenomenon of air breakdown when electric stress on the surfaces of a conductor exceeds certain values.

**BACKGROUND ART**

Ozone is used in a wide range of industrial applications such as in the bottling industry to disinfect bottles, in brewing, by the pharmaceutical industry as a disinfectant, in the manufacture of electric components to oxidise surface impurities to breakdown industrial waste like phenol and cyanide so that they become biodegradable, to oxidise mining waste, and for the treatment of harmful compounds such as heavy metals, ethanol and ascetics. It also oxidises phenolics, pesticides, detergents and aroic (smelly) compounds.

It has also been long recognised that polluted indoor air is a health hazard that causes disease, lost work days and in general reduces quality of life.

Pollution indoors can often exceed outdoor levels and the transmission of respiratory infections in indoor environments continues to be a substantial health concern.

There are many contaminants which contribute to indoor air pollution and the controlled treatment of living environments with ozone will substantially improve conditions.

Excessive levels of ozone can result in the poisoning of humans or animals and it is therefore necessary to control ozone outputs in relation to an environment being treated.

There are numerous enterprises which specialise in the production of ozone generating apparatus and treatments but to date available apparatus has tended to be technically crude, expensive and inefficient.

It is an object of the present invention to provide an ozone

generating apparatus which is efficient compact and one which can be produced at relatively modest cost and be tailored for specific situations.

Ozone is also used for water treatment purposes using what are known as aeration or venturi methods.

5 A typical venturi installation as is known in the art involves the placement of a ozone generating apparatus adjacent to a waterline. Ozone produced by the apparatus is introduced into a waterline using a venturi device placed in a waterline bi-pass from the waterline.

10 It is a further object of the present invention to provide an ozone generating apparatus for general purposes and one which is readily adapted for the treatment of water, air and other bodies of fluid.

Further objects and advantages of the present invention will become apparent from the ensuing description which is given by way of example.

## 15 DISCLOSURE OF INVENTION

According to the present invention there is provided a corona discharge apparatus comprising an elongate positive electrode, an elongate dielectric sleeve mounted co-axially with the positive charge electrode and an elongate negative electrode mounted co-axially with the dielectric sleeve  
20 characterised in that the elongate positive electrode is an interference fit with the negative dielectric.

The positive electrode can be a metal rod provided with an external thread.

25 The negative electrode can be provided with an irregular surface providing venting spaces between the outermost portions of the electrode and the dielectric sleeve.

The negative electrode can be metal mesh in the form of a cylindrical sleeve or wrap.

30 The apparatus can include an elongate tubular outer housing and means for creating a forced draft in an axial direction throughout the housing.

According to another aspect of the present invention there is

provided a corona discharge apparatus comprising positive (outer) and negative (inner) electrodes separated by an air gap and a dielectric member characterised in that the positive and negative electrodes and the dielectric member are co-axial and the air gap between the negative electrode and the dielectric is created by spacers.

The spacers can be resilient o-rings.

The air gap can be defined by the tubular electrode and the spacers.

The air gap is communicable with the interior of the negative electrode.

The inner electrode can be provided with wall apertures which allow air to enter and exit the air gap and internal blocks adapted to divert airflow to and from the air gap.

The inner and outer electrodes can be metal tubes.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Aspects of the present invention will now be described with reference to the accompanying drawings in which;

Figures 1 to 1d are diagrammatic side perspective views of aspects of an ozone generating apparatus in accordance with one possible embodiment of the present invention, and

Figure 2, 3 and 4 are top, side and exploded views of a further form of corona discharge unit for the ozone generating apparatus of the present invention, and

Figure 5a to 5d are systematic drawings of possible outer electrode arrangements for a corona discharge apparatus of the present invention, and

Figures 6 is a side view and partial cross-section of an electrode according to the present invention, and

Figure 7 is a cross-sectional drawing of the electrode of figure 6 taken at vii:vii.

With respect to figures 1 to 1(d) of the drawings apparatus according to the present invention may comprise a body generally indicated



by arrow 1 which includes a generally tubular outer casing 1 (shown in figure 1 only).

The casing 1a may be provided with vents 2, 3 and may include a carrying handle 4 and attachment means 5.

5 The casing may be cylindrical (as illustrated) square or rectangular (not shown).

The outer surface of the casing 1a of the body 1 may mount an auxiliary and coaxial fan (not shown).

10 Figures 1(b), 1(c) and 1(d) of the drawings are side perspective views of the device of the present invention with the casing 1a removed.

The device is provided with a base generally indicated by arrow 7 an ozone producing region indicated by arrow 8.

The ozone producing region 8 and an internal fan 9 may be fixed to the base 7 by inverted U-shaped rails 10.

15 The base 7 which may be moulded or fabricated in metal or plastic secures free ends 10a of the rails 10 and receives an electrical power cord 11.

The base 7 can house programmable control means (not shown) within a sealed housing 12.

20 The free (upper ends) of the rails 10 can provide support for a corona discharge apparatus generally indicated by arrow 13.

In the example illustrated the frame or casing of the fan 9 is a push fit on the rails 10. In the alternative the frame or body of the fan 9 may fit between the rails 10 in such a manner that it can be repositioned without  
25 the need for dismantling.

With respect to figures 4 to 6 of the drawings in accordance with a further possible embodiment of the present invention corona discharge apparatus generally indicated by arrow 15 may be housed within a tube generally indicated by arrow 16.

30 The tube 16 may be made of an ozone resistant material and be in many forms and sizes.

The function of the tube is to isolate the immediate environment

of the corona discharge apparatus from turbulent air which is induced or blown into the generator casing by the main fan and to furthermore improve delivery of ozone from the corona discharge unit.

5 In other respects the construction of the ozone generator is similar to that previously described.

The discharge unit 15 has positive and negative chargeable electrodes 17, 18 interposed by a dielectric element 19.

Positive electrode 17 can be in the form of a stainless steel rod or bolt charged via electrical connection 20.

10 The negatively charged electrode 18 may be in the form of a tubular wound or wrapped stainless steel mesh charged via an independent electrical connection (now shown).

The dielectric element 19 can be in the form of a ceramic tube.

15 Where the positively charged electrode 17 is in the form of a bolt the elements of the discharge unit can be conveniently assembled using a nut 21 and washer 22.

A resilient ring 23 can be interposed between washer 22 and the element 19 to lessen the risk of damage to same when assembly nut 21 is tightened.

20 The corona discharge unit 15 can be centraiased in tube 16 by a support 24.

The length of the mesh electrode 18 may be varied to suit.

As mentioned earlier the tube 16 can be of varying sizes and configurations.

25 In figure 5 the tube 16 is elongate and has inlet and outlet nozzles 25, and 26 of reduced size with a view to improving the delivery of ozone from the unit.

An auxiliary fan 27 may be positioned within the tube 16 to further enhance ozone delivery from the tube.

30 In some instances a glass tube corona discharge unit may be specified.

The corona discharge apparatus figures 5 to 5(d) illustrate other

aspects of the present invention.

In figure 5 the apparatus has two series wired negative electrodes 18.

In figure 5a the apparatus has four series connected negative electrodes 17 joined by a metal crimp bar 30.

Figure 5b is a sectional drawing taken at V(b):V(b) of figures 5 and 5a. The arrangement shows negative electrodes 18 in the form of a metal mesh wrap on the dielectric 19 where the free ends 32, of the mesh forming the electrode 18 are joined by a crimped bar 30, clamped and pulled taut by the crimp bar.

In figure 5c shows that a positive electrode 17 which is of an irregular surface shape can provide a corona discharge "skin" over the dielectric 19 through which air can pass. The depth of the corona discharge skin is approximately equivalent to the overall depth of the electrode 17. Various kinds of mesh, punched plates and the like can be provided to create this effect.

In figure 5d a positive electrode 17 is created by a material having lengthwise triangular fluting 33. Such an arrangement also provides a corona discharge skin through which air can freely pass.

With respect to figures 6 and 7 of the drawings the present invention also provides an corona discharge apparatus generally indicated by arrow 34 having positive (outer) and negative (inner) electrodes 35 and 36 respectively separated by an airgap 37 and a dielectric 38.

The electrodes 35, 36 and dielectric 38 are co-axial tubular members and the airgap 37 is created by spacers 39.

The spacers 39 can be o-ring seals made of a resilient ozone resistant material such a viton, and are set in grooves 40 in the face of the inner electrode 36.

The air gap 37 is an annular chamber defined by the inner walls of the dielectric 38, o-rings 39 and the outer walls of the inner electrode 36.

Access to the interiors of the air gap 37 is provided by apertures 41 and 41a in the walls of the inner electrode 36.

The inner electrode 35 and/or the dielectric can be connected to incoming and outgoing airlines 42, 43 respectively.

Single of dual plugs 44 prevent the passage of air into the interiors of the inner electrode 36.

5           When the electrodes 35, 36 are charged and a forced draft of air or oxygen is applied to airline 42 plugs 44 block the air and divert it into the interiors of the airgap 37 via the apertures 41, 41a.

The forced air draft now containing ozone is released to the airline 43 via apertures 41a.

10           The size and volume of the air gap can be adjusted by altering the spacings of the o-rings and/or their size.

The apparatus described is readily adapted for introducing ozone into fluid pipes or other bodies of water. The apparatus can also be used as a general purpose ozone generator for air treatment.

15           The apparatus of figures 6 and 7 can be readily adapted for ozone production from air. The inner tube electrode takes the place of the solid rod electrode of the previously described embodiment and the positive electrode is replaced by a negative mesh electrode.

20           The apparatus is constructed from readily available tubestocks and the robust construction ensures maximum operating efficiencies can be maintained.

Apparatus in accordance with the present invention has many advantages including:

- 25           (a) the ability to increase commercial profits by extending shelf life of agricultural and horticultural commodities during storage and transit,
- (b) improved quality of agricultural and horticultural commodities by inhibiting microbial growth on product surfaces,
- 30           (c) lowering the risk of pathogenic agents and cross-contamination in food handling environments,
- (d) the improved quality of indoor air by eliminating

unpleasant and hazardous odours and reducing risk of respiratory infections and effects of chemical pollutants,

- (e) the enhancements of hygiene by accessing and sterilising difficult to clean places, all of which can be achieved with no chemical residue build-up.

5

Aspects of the present invention have been described by way of example only and it will be appreciated that modifications and additions thereto may be made without departing from the scope thereof, as defined in the appended claims.

## CLAIMS:

1. Corona discharge apparatus comprising an elongate positive electrode, an elongate dielectric sleeve mounted co-axially with the positive electrode and an elongate negative electrode mounted co-axially with the dielectric sleeve characterised in that the elongate positive electrode is an interference fit on the elongate negative electrode.
2. Corona discharge means as claimed in claim 1 wherein the positive electrode is a metal rod provided with an external thread.
3. Corona discharge means as claimed in claim 1 wherein the negative electrode is provided with an irregular surface provide an air spaces between the outermost portions of the electrode and the dielectric sleeve.
4. Corona discharge means as claimed in claim 1 wherein the negative electrode is a metal mesh in the form of a cylindrical sleeve or wrap.
5. Corona discharge means as claimed in claim 1 including an elongate tubular outer housing and means for creating a forced draft in an axial direction throughout the housing.
6. Corona discharge apparatus comprising positive (outer) and negative (inner) electrodes separated by an air gap and a dielectric member characterised in that the positive and negative electrodes and the dielectric member are co-axial and the air gap between the negative electrode and the dielectric is created by spacers.
7. Corona discharge apparatus as claimed in claim 6 wherein the spacers are resilient O-rings.
8. Corona discharge apparatus as claimed in claim 6 wherein the air gap is defined by the tubular electrode and the spacers.
9. Corona discharge apparatus as claimed in claim 6 wherein the inner electrode is provided with wall apertures which allow air to enter and exit the air gap and internal blocks which divert airflow from the air gap.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization  
International Bureau

A PCT APPLICATION TO WHICH NATIONAL RIGHTS IN THE UNITED STATES ARE CLAIMED BY THE INVENTOR

(43) International Publication Date  
7 December 2000 (07.12.2000)

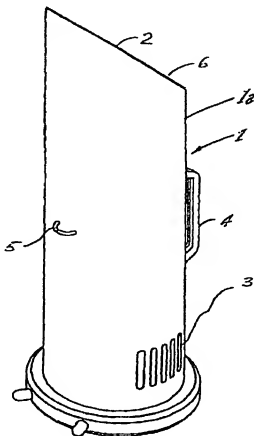
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- (81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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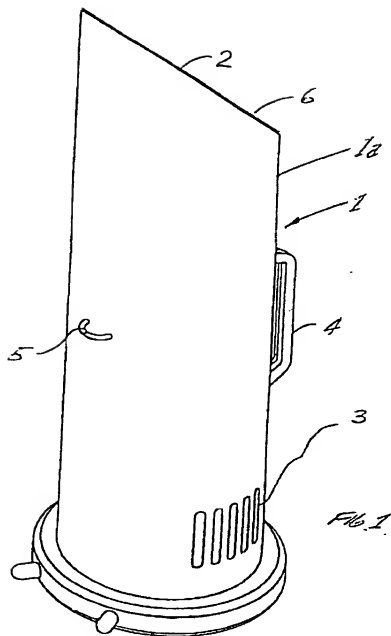
(54) Title: OZONE GENERATING APPARATUS



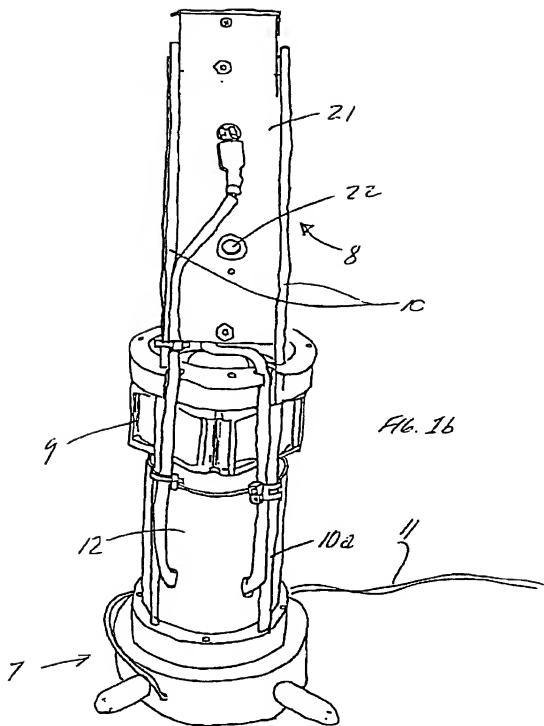
(57) Abstract: Corona discharge apparatus which is simply and robustly constructed from readily available materials can be used for producing ozone from air and in a body of water. All forms of apparatus are of a substantially elongate cylindrical configuration and in one form of the invention the apparatus can be readily adapted for ozone production in water to production from air.

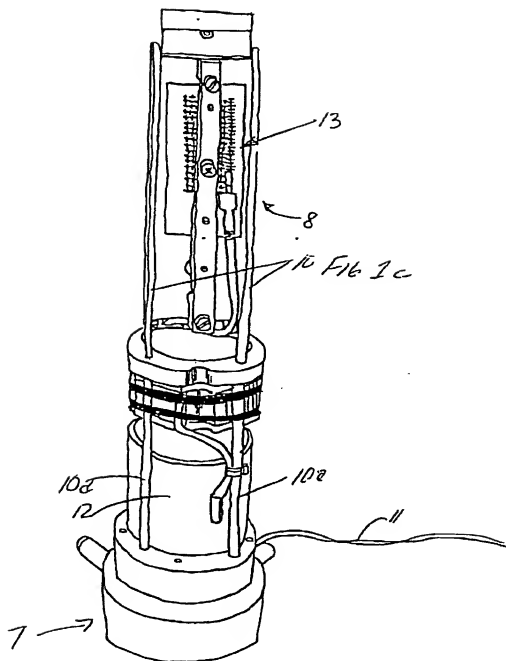


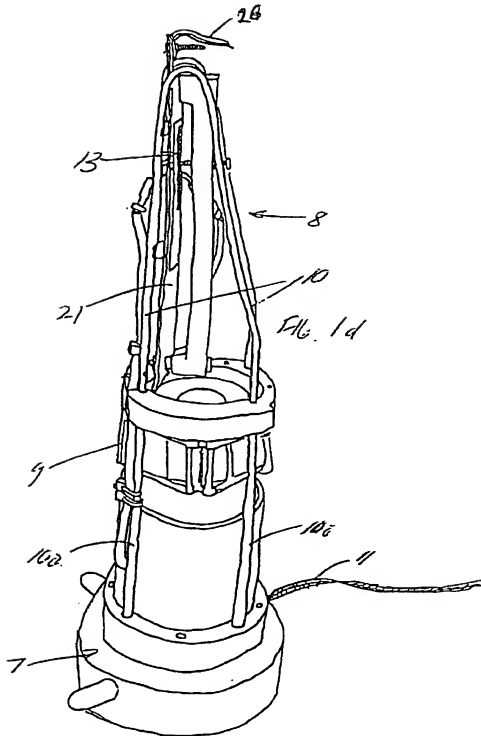
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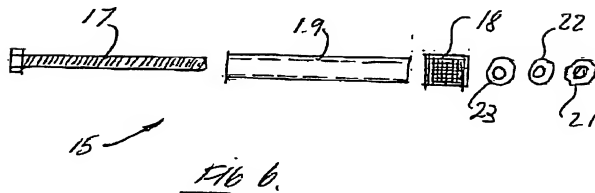
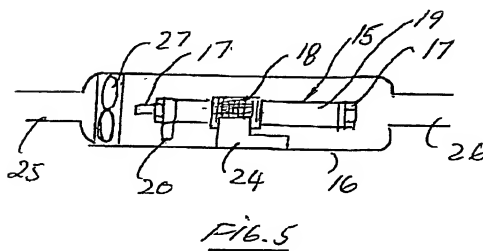
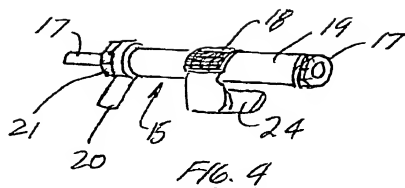












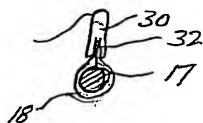
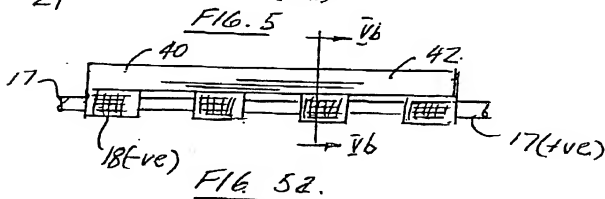
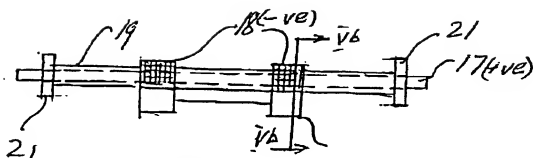


FIG 5b

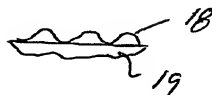


FIG 5c



FIG 5d



**DECLARATION AND POWER OF ATTORNEY - USA PATENT APPLICATION**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**Ozone Generating Apparatus**

the specification of which:

- (a) ☐ is attached hereto; or
- (b) ☐ was filed on \_\_\_\_\_ as Application No. 0/ \_\_\_\_\_ or Express Mail No., as Application No. not yet known \_\_\_\_\_ and was amended on \_\_\_\_\_ (if applicable); or
- (c) ☒ was described and claimed in PCT International Application PCT/AU00/00617 filed on 31 May 2000 and as amended under PCT Article 19 (if any) and/or under PCT Article 34 on \_\_\_\_\_ (if any).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above;

I acknowledge the duty to disclose information which is material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, § 1.56;

I hereby claim foreign priority benefits under Title 35, United States Code, § 119 of any foreign application(s) for patent, design or inventor's certificate or any PCT international application(s) listed below and have also identified below any foreign application(s) for patent, design or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed for the same subject matter having a filing date before that of the application(s) of which priority is claimed:

**PRIOR FOREIGN APPLICATION(S)**

| COUNTRY (OR INDICATE IF PCT) | APPLICATION NUMBER | DATE OF FILING (day, month, year) | PRIORITY CLAIMED UNDER 37 U.S.C. § 119 |
|------------------------------|--------------------|-----------------------------------|--|
| Australia                    | PQ0638             | 31 May 1999                       | Yes                                    |
| Australia                    | PQ5864             | 25 February 2000                  | Yes                                    |
|                              |                    |                                   |  |

I hereby claim the benefit under Title 35, United States Code, § 120 of any United States application(s) listed below, and insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code § 112, 1 acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56, which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Prior U.S.A. Application(s)

Application No.:                      Filing Date:                      Status:

POWER OF ATTORNEY: I hereby appoint the registrants of

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Customer No. 23908

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 100 1 of Title 18 of the United States Code and that such willful, false statements may jeopardize the validity of the application or any patent issued thereon.

Full name of sole or first inventor: John Lionel BRAUER

Inventor's signature John Brauer 18<sup>th</sup> Day March Month 2002 ~~2001~~

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Post Office Address: as above

Full name of second inventor: David Kerin Leigh NOLLER

Inventor's signature DKL Noller 8<sup>th</sup> Day March Month 2002 ~~2001~~

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Citizenship: Australian

Post Office Address: As above